The documentation and process conversion measures necessary to comply with this revision shall be completed by 21 November 1997

INCH POUND

MIL-PRF-19500/162C
21 August 1997
SUPERSEDING
MIL-S-19500/162B
27 July 1964

PERFORMANCE SPECIFICATION SHEET

SEMICONDUCTOR DEVICES, DIODE, SILICON, POWER RECTIFIER,
TYPES 1N1614, 1N1615, 1N1616, 1N4458, 1N4459, 1N1614R, 1N1615R, 1N1616R,
1N4458R, 1N4459R, JAN AND JANTX

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the performance requirements for silicon, power rectifier diodes. Two levels of product assurance are provided for each device as specified in MIL-PRF-19500.

1.2 Reverse types, (suffix R). Reverse and standard types are identical except: The standard types have the cathode connected to the stud; the reverse types have the anode connected to the stud. Designated values are applicable to both types. Reversed (anode to stud) units shall be marked with an R following the last digit in the type number.

1.3 Physical dimensions. See figure 1 (DO-4).

1.4 Maximum ratings.

Types	V_{RWM}	I_O		I_F	T_J and T_{STG}	I_{FSM} at: t = 1/120 s T_C = +150°C	Barometric pressure (reduced)
		T_C = +25°C 1/	T_C = +150°C				
	V (pk)	A dc	A dc	A dc	°C	A	mm Hg
1N1614, R	200	10	5	15	-65 to +175	100	8
1N1615, R	400	10	5	15	-65 to +175	100	8
1N1616, R	600	10	5	15	-65 to +175	100	16
1N4458, R	800	10	5	15	-65 to +175	100	30
1N4459, R	1,000	10	5	15	-65 to +175	100	54

1/ Derate linearly at 40 mA dc/°C above T_C = +25°C.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Defense Supply Center Columbus, ATTN: DSCC-VAT, 3990 East Broad Street, Columbus, OH 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATION

DEPARTMENT OF DEFENSE

MIL-PRF-19500 - Semiconductor Devices, General Specification for.

STANDARD

MILITARY

MIL-STD-750 - Test Methods for Semiconductor Devices.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated specifications or specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Qualification. Devices furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list before contract award (see 4.2 and 6.3).

3.2 Associated detail specification. The individual item requirements shall be in accordance with MIL-PRF-19500, and as specified herein.

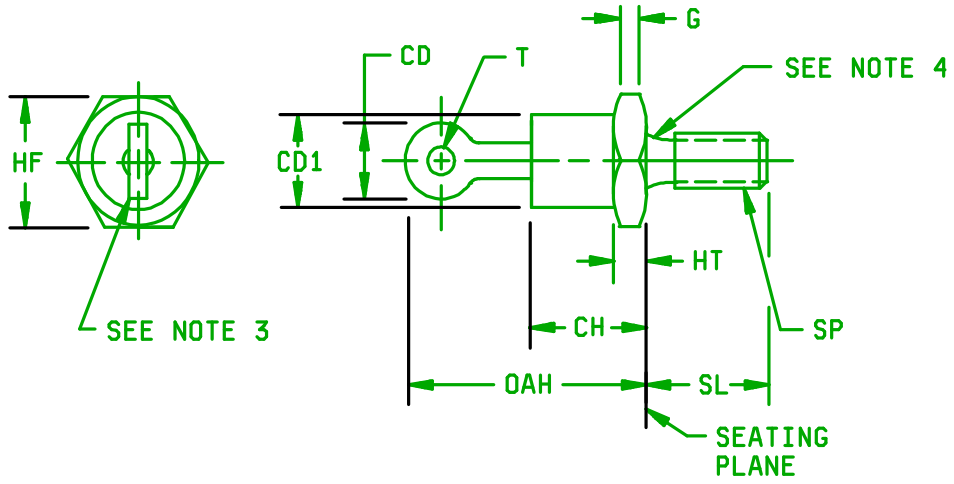
3.3 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500.

3.4 Interface requirements and physical dimensions. The interface requirements and physical dimensions shall be as specified in MIL-PRF-19500 and as specified on figure 1 herein.

3.4.1 Lead material and finish. Lead finish shall be solderable in accordance with MIL-PRF-19500, and as specified herein. Where a choice of lead finish is desired, it shall be specified in the acquisition document (see 6.2).

3.4.2 Construction. These devices shall be constructed in a manner and using materials which enable the devices to meet the applicable requirements on MIL-PRF-19500 and this document.

3.5 Marking. Marking shall be in accordance with MIL-PRF-19500. The polarity shall be indicated by a graphic symbol with the arrow pointing to the cathode end for forward bias. The reversed units shall also be marked with an R following the last digit in the type number.



Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD		0.250		6.35	9
CD1		0.424		10.77	
CH		0.405		10.29	
G	0.060		1.52		
HF	0.424	0.437	10.77	11.10	
HT	0.075	0.175	1.91	4.45	
OAH		0.800		20.32	
SP					6,7,8
SL	0.422	0.453	10.72	11.51	
T	0.060		1.52		

NOTES:
1. Dimensions are in inches.
2. Metric equivalents are given for general information only.
3. Angular orientation of this terminal is undefined.
4. Diameter of unthreaded portion 0.189 inch (4.80 mm) maximum; 0.163 inch (4.14 mm) minimum.
5. The A.S.A. thread reference is 10-32UNF2A (unplated).
6. The maximum diameter of plated threads shall be basic pitch diameter 0.169 inch (4.31mm).
7. Unit shall not be damaged by torque of 15 inch-pound applied to 10-32NF2B nut assembled on thread.
8. Complete threads shall extend to within 2.5 threads of the seating plane.
9. Terminal end shape is unrestricted.

FIGURE 1. Physical dimensions.

3.6 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in 1.3, 1.4 and table I.

3.7 Electrical test requirements. The electrical test requirements shall be the subgroups specified in 4.4.2 and 4.4.3.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.2).

b. Screening (see 4.3)

c. Conformance inspection (see 4.4).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500 and as specified herein. Tests in either polarity shall be sufficient to obtain qualification approval of both polarities.

4.3 Screening (JANTX level). Screening shall be in accordance with appendix E, table IV of MIL-PRF-19500 and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screen (see appendix E, table IV MIL-PRF-19500)	Measurement
3b 1/	Surge, (see 4.3.1)
3c 1/	Thermal impedance (see 4.3.2)
9	Not applicable
11	I_{R1} and V_F
12	See 4.3.3
13	Subgroup 2 of table I herein: $\Delta I_{R1} \leq$ 100 percent of initial reading or ± 5.0 µA dc, whichever is greater. $\Delta V_F \leq \pm$ 0.1 V dc.

1/ Surge shall precede thermal impedance and shall be performed any time after sealing provided temperature cycling is performed in accordance with MIL-PRF-19500, screen 3 prior to this thermal test.

4.3.1 Surge current. Surge current, see MIL-STD-750, method 4066. I_O = 0; $V_{RM}(W)$ = 0; I_{FSM} = 100 A; six surges; T_A = room ambient as defined in the general requirements of 4.5 of MIL-STD-750. One surge per minute maximum. t_p = 8.3 ms.

4.3.2 Thermal impedance $Z_{\theta JX}$ measurements for screening. The $Z_{\theta JX}$ measurements shall be performed in accordance with MIL-STD-750, method 3101. The maximum limit and conditions for $Z_{\theta JX}$ in screening (appendix E, table IV of MIL-PRF-19500) shall be derived by each vendor by means of process control of actual measurements which characterizes the die attach process. When three lot date codes have exhibited control, the data from these three lots will be used to establish a fixed screening limit (not to exceed the group A limit). Once a fixed limit has been established, monitor all future sealing lots using a sample from each lot.

4.3.2.1 Thermal impedance ($Z_{\theta JX}$ measurements) for initial qualification or requalification. The $Z_{\theta JX}$ measurements shall be performed in accordance with MIL-STD-750, method 3101 (read and record value $Z_{\theta JX}$) derived conditions, limits, and thermal response curve shall be supplied to the qualifying activity on the qualification lot prior to qualification approval.

4.3.3 Power burn-in conditions. Power burn-in conditions are as follows: Method 1038, condition A of MIL-STD-750, T_A = +150°C; V_{RWM} = V_{RWM} (see 1.3); I_O = 0; t = 48 hours.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500 and as specified herein.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with appendix E, table V of MIL-PRF-19500, and table I herein. The following test conditions shall be used for $Z_{\theta JX}$ in a group A, subgroup 2 inspection:

a. I_M measuring current ..... 50 to 250 mA.

b. I_H forward heating current..... 3 to 10 A.

c. t_H heating time ..... 150 to 400 ms.

d. t_{MD} measurement delay time..... 50 to 300 µs maximum.

The maximum limit for $Z_{\theta Jx}$ in group A, subgroup 2 is $Z_{\theta Jx}$ (maximum) = 4.5°C/W.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table VIb (JANTX and JANTXV) of MIL-PRF-19500 and herein. Electrical measurements (end-points) shall be I_{R1} and V_F in accordance with table I, subgroup 2 herein.

4.4.2.1 Group B inspection, appendix E, table VIb (JANTX and JANTXV) of MIL-PRF-19500.

Subgroup	Method	Conditions
B2	4016	I_{FSM} = 100 A (pk); 10 surges of 8.3 ms each at 1 minute intervals, super-imposed on I_O = 5 A dc; V_{RWM} = rated V_{RWM} (see 1.4); T_C = +150°C.
B3	1037	.25 rated $I_O \leq I_O$ applied ≤ rated I_O; 2,000 cycles.

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table VII of MIL-PRF-19500 and as follows. Electrical measurements (end-points) shall be I_{R1} and V_F in accordance with table I, subgroup 2 herein.

4.4.3.1 Group C inspection, appendix E, table VII of MIL-PRF-19500.

Subgroup	Method	Conditions
C2	2036	Test condition A, 10 pounds, t = 15 ±3s.
C2	2036	Test condition D1, 10 ounce/inch, t = 15 ±3s.
C2	2036	Test condition F, method B, 5 pounds, t = 15 ±3s.
C2	2036	Test condition D2, method B, 15 pounds, t = 15 ±3s.
C6	1037	.25 rated $I_O \leq I_O$ applied ≤ rated I_O; 2,000 cycles.

4.4.4 Group E inspection. Group E inspection shall be conducted in accordance with the conditions specified for subgroup testing in appendix E, table IX of MIL-PRF-19500 and as follows. Electrical measurements (end-points) shall be I_{R1} and V_F in accordance with table I, subgroup 2 herein.

4.4.4.1 Group E inspection, appendix E, table IX of MIL-PRF-19500.

Subgroup	Method	Conditions
E5	1001	Hg = rated Hg, t = 60s, (see 1.4), V_R = rated V_{RWM}.

4.5 Methods of inspection. Methods of inspection shall be specified in the appropriate tables and as follows.

4.5.1 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of MIL-STD-750.

4.5.2 Inspection of conditions. Unless otherwise specified, all inspections shall be conducted at an ambient temperature T_A = +25°C ±3°C.

4.5.3 Thermal resistance. Thermal resistance measurement shall be performed in accordance with MIL-STD-750, method 3101 or 4081. Forced moving air or draft shall not be permitted across the device during test.

TABLE I. Group A inspection.

Inspection 1/	MIL-STD-750			Limits		Unit
	Method	Conditions	Symbol	Min	Max	
Subgroup 1						
Visual and mechanical inspection	2071					
Subgroup 2						
Forward voltage	4011	I_F = 15 A(pk), $t_P \leq$ 8.3 ms, duty cycle ≤ 2 percent, pulsed (see 4.5.1)	V_F		1.5	V (pk)
Reverse current leakage	4016	DC method; V_R = rated V_{RWM} (see 1.4)	I_{R1}		50	µA dc
Thermal impedance	3101	See 4.4.1	$Z_{\theta JX}$		4.5	°C/W
Subgroup 3						
Reverse current leakage	4016	DC method; V_R = rated V_{RWM} (see 1.4) T_C = +150°C	I_{R2}		500	µA dc
Subgroup 4						
Not applicable						
Subgroups 5, 6, and 7						
Not applicable						

1/ For sampling plan, see MIL-PRF-19500.

5. PACKAGING

5.1 Packaging. Packaging shall prevent mechanical damage of the devices during shipping and handling and shall not be detrimental to the device. When actual packaging of material is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Points' packaging activity within the Military Department or Defense Agency, or within the Military Departments' System Command. Packaging data retrieval is available from the managing Military Departments' or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

5.2 Marking. Unless otherwise specified (see 6.2), marking shall be in accordance with MIL-STD-129.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Notes. The notes specified in MIL-PRF-19500 are applicable to this specification.

6.2 Acquisition requirements. See MIL- PRF-19500.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL No.19500 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center Columbus, ATTN: DSCC-VQE, 3990 East Broad Street, Columbus, OH 43216-5000.

6.4 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

CONCLUDING MATERIAL

Custodians:
Army - CR
Navy - EC
Air Force - 17

Review activities:
Army - AR, EA, MI
Air Force - 19, 80, 85, 99
Navy - AS, CG, MC, SH

Preparing activity:
DLA - CC

(Project 5961-1622)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.

2. The submitter of this form must complete blocks 4, 5, 6, and 7.

3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:	**1. DOCUMENT NUMBER** MIL-PRF-19500/162C	**2. DOCUMENT DATE (YYMMDD)** 970821

3. DOCUMENT TITLE SEMICONDUCTOR DEVICES, DIODE, SILICON, POWER RECTIFIER, TYPES 1N1614, 1N1615, 1N1616, 1N4458, 1N4459, 1N1614R, 1N1615R, 1N1616R, 1N4458R, 1N4459R, JAN AND JANTX

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle initial)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME Alan Barone	b. TELEPHONE (Include Area Code) (1) Commercial (614)692-0510 (2) AUTOVON 850-0510
c. ADDRESS (Include Zip Code) Defense Supply Center Columbus, ATTN: DSCC-VAT, 3990 East Broad Street, Columbus, OH 43216-5000	**IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:** Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340